

***Standards and Guidelines for  
CWHR Species Models***

***California Wildlife Habitat Relationships System  
California Department of Fish and Game  
California Interagency Wildlife Task Group***

***December, 2000***

## **Preface**

This document represents an update to an October, 1982 report entitled “California Wildlife and Fish Habitat Relationships (WFHR) System: Products and Standards for Wildlife.” From 1982 until the present, this document has been invaluable to developers of the California Wildlife Habitat Relationships (CWHR) System, identifying all of the system components and providing standard definitions for all of the terms used within them. It has been the document provided to experts developing model ratings for all new species added since the system was introduced.

There are several reasons for updating the standards at this time:

1. The document is nearly 20 years old. There have been many changes to species taxonomy and nomenclature during that time. The platform for storing and distributing the data for the matrix models has changed from a mainframe computer to a personal computer so many of the standards for how to record new data no longer apply.
2. There have been changes to some of the categories used in the matrix model. For example, location categories have gone through many changes. There are newer schema for dividing the California into ecological regions and hydrologic units; boundaries for Bureau of Land Management (BLM) Field Office Districts and Department of Fish and Game (DFG) Regions have changed.
3. The system now includes Geographic Information System (GIS) data so standards and guidelines for developing and maintaining this data must be added.
4. What were once termed “system components” or “products” because they existed in separate formats have now been integrated into a single user application which is stored and distributed electronically. Life history accounts no longer exist as publications but are updated and distributed along with the database models.

A single species model might now be thought of as three components which must be updated simultaneously – the life history account, the database model which is queried within the system software, and the GIS coverage representing distribution by season throughout the state.

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## ***Life History Account***

## **LIFE HISTORY ACCOUNT**

The Life History Account documents the distribution, habitat use and life history of the species in a brief narrative. It is intended to provide the user with an introduction to the species and an information basis for range maps, habitat relationships and habitat ratings. The account is intended to be intermediate between the information in a typical field guide and that in a detailed literature review. The format and definitions are as follows.

<b>Species ID</b>	<b>Common Name</b>	<b>Scientific Name</b>
<b>Family</b>	<b>Order</b>	<b>Class</b>

Use taxonomy and nomenclature from [http://www.dfg.ca.gov/whdab/species\\_list.pdf](http://www.dfg.ca.gov/whdab/species_list.pdf). This list is updated regularly.

**Written by:**  
**Reviewed by:**  
**Edited by:**  
**Updated by:**

### **DISTRIBUTION, ABUNDANCE, AND SEASONALITY**

In support of the accompanying range map, document the general distribution of the species. Cite specific information on the range, major habitats used, relative abundance, seasonal occurrence, and origin (native or exotic) in California. When possible, refer to standard geographic features as they are identified on the USDA Ecological Units of California (August, 1994) and describe elevation to the nearest 100 feet. Report as meters rounded to 10ths with feet in parentheses.

### **SPECIFIC HABITAT REQUIREMENTS**

<b>Feeding:</b>	Document the foraging strategy and major food items used seasonally and by distinct life stages of the species.
<b>Cover:</b>	Document the major cover needs and describe the habitat resources used seasonally and by distinct life stages of the species.
<b>Reproduction:</b>	Document the specific habitat needs for key events in the annual reproductive cycle: e.g. courtship, breeding, nesting, parturition, fledging, and lactation. Emphasize spatial and temporal habitat requirements for reproduction rather than specific mating behaviors.
<b>Water:</b>	Document the water needs, qualitatively and quantitatively. Wherever possible, emphasize spatial requirements such as distance to water and

temporal requirements such as seasonal availability.

**Pattern:** Document the mix and interspersion of habitat conditions required by the species; distinguish seasonally if appropriate.

## **SPECIES LIFE HISTORY**

**Activity Patterns:** Document daily and seasonal activity patterns that might be important to management: e.g. nocturnal, hibernates, aestivates.

### **Seasonal Movements/**

**Migration:** Document the nature of seasonal movements and identify associated special habitat needs.

**Home Range:** Document the variation in home range sizes and shapes. Include density values here. Report homing experiments as such.

**Territory:** Document the extent to which territories are defended and the nature of those territories.

**Reproduction:** Document the significant dates in the reproductive process, the reproductive potential of the species, and the nature of reproductive units: e.g. solitary breeding pairs, colonies.

**Niche:** Document the species relationships with predators, competitors, disease, parasites, and weather, and its ecological role.

## **REFERENCES**

Cite all references, whether literature or personal communications, in standard Journal of Wildlife Management format. (<http://www.wildlife.org/journal.html>)

**Editor's Notes:** Use the "active" voice wherever possible.  
Quantify habitat requirements wherever possible.  
For updates, start literature searches with cited authors from original account. Add to, rather than replace, citations.  
When using secondary sources to cite original research, authors should cite both sources. (e.g. Smith, 1992 as cited in Jones, 1994)  
When citing their own original research, authors should cite themselves in the third person..

## ***Database Model***

## MODEL ASSUMPTIONS

The CWHR System rests on a set of general assumptions. In addition, there are a number of specific assumptions which model raters must all adhere to when assigning suitability values to habitats and importance levels to elements for any given species. General and specific system assumptions are listed below.

### GENERAL ASSUMPTIONS

1. Wildlife species occurrence and abundance are strongly influenced by habitat conditions.
2. Wildlife habitat can be described by a set of environmental characteristics.
3. Relative suitability values (i.e., HIGH, MODERATE, LOW, UNSUITABLE) of habitats and the relative importance of special habitat elements may be determined for each species.
4. Habitat suitability value is uniform for a species throughout its range in California for the specified habitat.

### SPECIFIC ASSUMPTIONS

1. Habitat ratings reflect values only for that species.
2. Habitats for species that require juxtaposition of two or more habitats are individually rated as if the other habitats are available in the proper mix.
3. Ratings assume that all special habitat elements are present in adequate amounts if they are typical components of the habitat.
4. Ratings assume that adequate habitat amounts and patch sizes exist.

## HABITAT CLASSIFICATION SCHEME USED IN THE MODELS

The habitat classification scheme used in the models is described in the publication “A Guide to Wildlife Habitats of California” (Mayer and Laudenslayer, 1988). There are two supplements to this guide. One is a description of the eight agricultural types which replace Cropland and Orchard-Vineyard in the 1988 publication. Another is a crosswalk to “A Manual of California Vegetation” (Sawyer and Keeler-Wolf, 1995), a widely-used vegetation classification scheme for California developed since publication of the original guide. Current habitat descriptions and crosswalks may also be referenced within the CWHR software.

### THE CONNECTION BETWEEN HABITATS AND SPECIAL HABITAT ELEMENTS

One of the specific model assumptions is that all special habitat elements are present in adequate amounts if they are typical components of the habitat. Model raters and model users often ask for explicitness on which special elements they may assume are typical in any given habitat. The standards set below were developed in 1994 by Irene Timossi, Barrett Garrison, and Marshall White and should be used for all new models. The current models have also been evaluated to ensure that they follow this logic. Thus, users may be confident in the following standard assumptions regarding elements.

#### ELEMENT ASSUMPTIONS

1. If a habitat can be found next to another habitat that contains an element, that element is assumed to be present. For example, large logs in various states of decay may be assumed present in the shore zone of marine habitat because of the adjacency of other habitats.
2. An element is assumed to be present unless it is never present, either in the habitat being evaluated or any other habitat that might occur nearby.

As a result of these assumptions, most habitats possess virtually all of the elements. The exceptions are listed below.

CWHR Habitat	Dominant Species or Dominant Associates	Elements Assumed Absent (CWHR users do <u>not</u> have to delete these elements during queries.)
<b>Tree-Dominated Habitats (27 types)</b>		
Aspen (ASP)	Willow, Alder, Black Cottonwood	kelp, salt ponds, tidepools

<b>CWHR Habitat</b>	<b>Dominant Species or Dominant Associates</b>	<b>Elements Assumed Absent</b> (CWHR users do <u>not</u> have to delete these elements during queries.)
Blue Oak Woodland (BOW)	Interior Live Oak, Valley Oak, Juniper	kelp; salt ponds; sand dunes; tidepools; trees, fir
Blue Oak-Foothill Pine (BOP)	Interior Live Oak, Valley Oak, California Buckeye	kelp; salt ponds; sand dunes; tidepools; trees, fir
Closed-Cone Pine-Cypress (CPC)	Tecate, Cuyamaca, Foothill Pine	none
Coastal Oak Woodland (COW)	White Oak, California Black Oak, Engelmann Oak	none
Eucalyptus (EUC)	Blue Gum, Red Gum	none
Desert Riparian (DRI)	Tamarisk, Velvet Ash, Mesquite	kelp; tidepools; trees, fir
Douglas-Fir (DFR)	Live Oaks, Tanoak, Ponderosa Pine	none
Eastside Pine (EPN)	Ponderosa Pine, Jeffrey Pine, White Fir	kelp, salt ponds, sand dunes, tidepools
Jeffrey Pine (JPN)	Ponderosa Pine, Coulter Pine, Sugar Pine	kelp, salt ponds, sand dunes, tidepools
Joshua Tree (JST)	Juniper, Singleleaf Pinyon, Mojave Yucca	kelp; log, large rotten; log, large sound; log, large hollow; snag, large rotten; snag, large sound; tidepools
Juniper (JUN)	White Fir, Jeffrey Pine, Ponderosa Pine	kelp, tidepools
Klamath Mixed-Conifer (KMC)	White Fir, Douglas-Fir, Ponderosa Pine	kelp, salt ponds, tidepools
Lodgepole Pine (LPN)	Aspen, Mountain Hemlock, Red Fir	kelp, salt ponds, sand dunes, tidepools
Montane Hardwood (MHW)	Canyon Live Oak, Douglas Fir, Knobcone Pine	kelp, salt ponds, tidepools

<b>CWHR Habitat</b>	<b>Dominant Species or Dominant Associates</b>	<b>Elements Assumed Absent</b> (CWHR users do <u>not</u> have to delete these elements during queries.)
Montane Hardwood-Conifer (MHC)	Ponderosa Pine, Douglas Fir, Incense Cedar	kelp, salt ponds, tidepools
Montane Riparian (MRI)	Black Cottonwood, White Alder, Bigleaf Maple	kelp, salt ponds, tidepools
Palm Oasis (POS)	Coyote Willow, Velvet Ash, Sycamore	acorns; cones; kelp; tidepools; trees, fir
Pinyon-Juniper (PJN)	Oaks, Mojave Yucca, Ponderosa Pine	kelp, tidepools
Ponderosa Pine (PPN)	White Fir, Incense Cedar, Coulter Pine	kelp, salt ponds, tidepools
Red Fir (RFR)	Noble Fir, White Fir, Lodgepole Pine	kelp, salt ponds, sand dunes, tidepools
Redwood (RDW)	Sitka Spruce, Grand Fir, Douglas Fir	none
Sierran Mixed-Conifer (SMC)	White Fir, Douglas Fir, Ponderosa Pine	kelp, salt ponds, tidepools
Subalpine Conifer (SCN)	Engelmann Spruce, Subalpine Fir, Mountain Hemlock	kelp, salt ponds, sand dunes, tidepools
Valley-Foothill Riparian (VRI)	Cottonwood, Sycamore, Valley Oak	kelp; trees, fir
Valley Oak Woodland (VOW)	Sycamore, Black Walnut, Foothill Pine	kelp; sand dunes; tidepools; trees, fir
White Fir (WFR)	Live Oak, Jeffrey Pine, Sugar Pine	kelp, salt ponds, tidepools
<b>Shrub-Dominated Habitats (12 types)</b>		
Alkali Desert Scrub (ASC)	Saltbush, Sagebrush, Creosotebush	kelp, tidepools
Alpine Dwarf-Shrub (ADS)	Creambush Oceanspray, Greene Goldenweed, Mountain White Heather	kelp, tidepools

<b>CWHR Habitat</b>	<b>Dominant Species or Dominant Associates</b>	<b>Elements Assumed Absent</b> (CWHR users do <u>not</u> have to delete these elements during queries.)
Bitterbrush (BBR)	Big Sagebrush, Rabbitbrush, Mormon Tea	kelp, tidepools
Chamise-Redshank Chaparral (CRC)	Toyon, Ceanothus, Sugar Sumac	kelp, tidepools
Coastal Scrub (CSC)	Lupine, Coyotebush, Sagebrush	none
Desert Scrub (DSC)	Creasotebush, Catclaw Acacia, Desert Agave	kelp, tidepools
Desert Succulent Shrub (DSS)	Octillo, Mojave Yucca, Desert Agave	acorns; kelp; tidepools; trees, fir; trees, pine
Desert Wash (DSW)	Paloverde, Desert Ironwood, Mesquite	kelp; log, large rotten; log, large sound; log, large hollow; snag, large rotten; snag, large sound; tidepools; trees, fir
Low Sage (LSG)	Rabbitbrush, Bitterbrush, Winter Fat	kelp, tidepools
Mixed Chaparral (MCH)	Oaks, Ceanothus, Manzanita	kelp, tidepools
Montane Chaparral (MCP)	Ceanothus, Manzanita, Bitter Cherry	kelp, salt ponds, sand dunes, tidepools
Sagebrush (SGB)	Rabbitbrush, Sagebrush, Gooseberry	kelp, tidepools
<b>Herbaceous-Dominated Habitats (6 types)</b>		
Annual Grassland (AGS)	Wild Oats, Soft Chess, Brome	none
Freshwater Emergent Wetland (FEW)	Big Leaf Sedge, Bulrush, Redroot Nut Grass	none
Saline Emergent Wetland (SEW)	Cordgrass, Pickleweed, Bulrush	trees, fir

<b>CWHR Habitat</b>	<b>Dominant Species or Dominant Associates</b>	<b>Elements Assumed Absent</b> (CWHR users do <u>not</u> have to delete these elements during queries.)
Pasture (PAS)	Bermuda Grass, Ryegrass, Tall Fescue	none
Perennial Grassland (PGS)	California Oatgrass, Hairgrass, Sweet Vernalgrass	none
Wet Meadow (WTM)	Thingrass, Sedge, Spikerush	kelp, tidepools
<b>Agricultural and Developed Habitats (9 types)</b>		
Dryland Grain Crops (DGR)	Cereal Rye, Barley, Wheat	none
Deciduous Orchard (DOR)	Almonds, Walnuts, Peaches	none
Evergreen Orchard (EOR)	Oranges, Avocados, Lemons	none
Irrigated Hayfield (IRH)	Alfalfa, Hay	none
Irrigated Grain and Seed Crops (IGR)	Corn, Dry Beans, Safflower	none
Irrigated Row and Field Crops (IRF)	Tomatoes, Cotton, Lettuce	none
Rice (RIC)	Rice	none
Urban (URB)	Grass Lawns, Trees, Hedges	none
Vineyard (VIN)	Grapes, Kiwi Fruit, Boysenberries	none
<b>Aquatic Habitats (4 types)</b>		
Estuarine (EST)	Plankton, Algae, Eel Grass	none
Lacustrine (LAC)	Plankton, Duckweed, Water Willies	none

<b>CWHR Habitat</b>	<b>Dominant Species or Dominant Associates</b>	<b>Elements Assumed Absent</b> (CWHR users do <u>not</u> have to delete these elements during queries.)
Marine (MAR)	Plankton, Algae, Kelp	Stage 1 (pelagic) – acorns, amphibians, aquatics, bogs, brush pile, buildings, burrow, campground, cave, cliff, cones, duff, dump, eggs, fences, fern, flowers, forbs, fruits, fungi, grain, graminoids and grass interfaces, insects, lakes, layers, lichens, lithic, litter, mammals – medium and small, moss, mud flats, nectar, nest box, nest island, nuts, pack stations, ponds, riparian, rivers, rock, roots, salt ponds, sand dune, sap, seeds, shrubs and shrub interfaces, soils, springs, steep slopes, streams, stumps, talus, transmission lines, tree leaves, trees and tree interfaces, vernal pools, water – fast, slow and man created, water/agriculture
		Stages 2-4 (subtidal, intertidal, shore, respectively) – none
Riverine (RIV)	Water Moss, Algae, Duckweed	none
<b>Non-Vegetated Habitats (1 type)</b>		
Barren (BAR)	Rock, Pavement, Sand	none

## STANDARD DEFINITIONS FOR SPECIES DATABASE MODEL

Model raters should use these definitions when completing or updating the Template for Species Database Model which follows.

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### TAXONOMY:

**Common Name:**

**Scientific Name:**

**Class:**

**Family:**

**Order:**

Use taxonomy and nomenclature from [http://www.dfg.ca.gov/whdab/species\\_list.pdf](http://www.dfg.ca.gov/whdab/species_list.pdf). This list is updated regularly.

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### IDENTIFICATION:

**CWHR ID Code:** 4-digit alpha-numeric code assigned to the species.

**AOU#:** ID from most recently published list of the American Ornithologists Union; birds only.

**TNC ID Code:** ID from The Nature Conservancy; natives only.

If no code exists, leave blank.

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### LIFE HISTORY ATTRIBUTES:

**Daily Activity:** Indicates the time periods when the species is active (not just most active) foraging, traveling, etc. Animals that are most active at dawn and dusk but are also active throughout the day and night ( e.g., deer) are circadian, not crepuscular.

Circadian (C): Active during all parts of 24-hour period.

Diurnal (D): Active only during daylight.

Nocturnal (N): Active only during darkness.

Crepuscular (P): Active only at dawn and dusk.

**Seasonal Activity:** Hibernate and aestivate are used in the broadest sense of the terms (i.e., include facultative hibernators such as raccoons and bears).

Yearlong (Y): Active during all months.

Hibernate (H): Inactive during winter.

Aestivate (A): Inactive during summer.

**Migration:** This identifies random or periodic movements to different habitats.

Unpredictable movements (U): Individuals perform irregular, unpredictable movements.

Local migrator (L): Regular seasonal migrations generally limited to less than 100 miles travel distance; generally implies within-state migrations as the norm.

Distant migrator (D): Regular seasonal migrations generally longer than 100 miles travel distance; generally implies interstate migrations as the norm.

Non-migratory (-): Do not engage in predictable movements away from normal home range during the year. Dispersal of juveniles is not considered a migration.

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## **SPECIAL STATUS:**

All of the following are tracked:

- Federal Endangered (California Natural Diversity Database or CNDDDB.)
- Federal Threatened (CNDDDB)
- California Endangered (CNDDDB)
- California Threatened (CNDDDB)
- California Fully-Protected (Fish and Game Code 3511 birds; 4700 mammals; 5050 reptiles and amphibians)
- California Protected (Title 14 CCR 41 amphibians; 42 reptiles; Fish and Game Code 4500 marine mammals)
- California Species of Special Concern (CNDDDB)
- Federally-Proposed Endangered (CNDDDB)

Federally-Proposed Threatened (CNDDDB)  
Federal Candidate (CNDDDB)  
BLM Sensitive (BLM designation)  
USFS Sensitive (USFS designation)  
CDF Sensitive (California Board of Forestry designation)  
Harvest (Fish and Game Code 3500 birds; 3950 mammals)

Model raters may leave this blank for CWHR staff to complete.

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**SUBSPECIES:**

**STATUS:**

Note any special status subspecies, using the categories listed above.  
Model raters may leave this blank for CWHR staff to complete.

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**LOCATION and SEASON IN LOCATION:**

Model raters should at minimum delineate seasonal distributions on a 1:1,000,000 scale map using the guidelines for map review contained in this document. CWHR staff will digitize this into a GIS coverage to derive the appropriate location predictions and season-in-location predictions for the database models.

All of the following location categories are tracked:

Counties	Counties
DFG Regions	DFG administrative units
BLM Field Offices	BLM administrative units
CERES Bioregions	Terrestrial scheme adopted by the California Biodiversity Council (CBC)
Calwater Hydrologic Regions	Hydrologic regions from GIS coverage Calwater 2.0
Latitlong Blocks	1 degree x 1 degree blocks of latitude and longitude
National Forests	Forests managed by the USDA National Forest Service
USDA Ecoregions	Terrestrial scheme developed by USDA Forest Service and adopted by the California Interagency Wildlife Task Group (CIWTG)

Season in location is defined as follows:

Yearlong (present all seasons)  
Summer Range (summer only; spring-summer, summer-fall, spring-fall)  
Winter Range (winter only, fall-winter, winter-spring, fall-spring)  
Migration-Only Range (fall only, spring only, fall and spring; this is not mapped.)

Spring: March 1 to May 31  
Summer: June 1 to July 31

Fall: August 1 to November 30  
Winter: December 1 to February 28

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## **HABITAT SUITABILITY and SEASON IN HABITAT:**

Habitats, size/age classes, and canopy closure classes are fully-described in “A Guide to Wildlife Habitats of California” (Mayer and Laudenslayer, 1988) and a more recent supplement describing agricultural types added since publication. There are a total of 59 habitats in the CWHR System with up to 17 combinations of size/age class and canopy closure class per habitat.

Habitat suitability ratings are defined for each of three life requisites – reproduction, cover and feeding – for each size/age and canopy closure class in each habitat. Ratings are defined as follows:

High (H):	Meet the life history need in support of a relatively high population density (as implied by probability of occurrence).
Medium (M):	Meet the life history need in support of a relatively moderate population density (as implied by probability of occurrence).
Low(N):	Meet the life history need in support of a relatively low population density (as implied by probability of occurrence).
Not Used (–):	The species is not expected to occur in the habitat.

Note that high, moderate and low densities are relative to the individual species being evaluated.. Some species occur at low population densities and are rare even in optimum habitats. Conversely, some species can occur at high population densities in poor quality habitats, if those habitats are functioning as “sinks” or overflow areas adjacent to high quality habitats.

Season in Habitat is defined using the following categories:

Yearlong (present all seasons)  
Summer Range (summer only; spring-summer, summer-fall, spring-fall)  
Winter Range (winter only, fall-winter, winter-spring, fall-spring)  
Migration-Only Range (fall only, spring only, fall and spring)

Spring: March 1 to May 31  
Summer: June 1 to July 31  
Fall: August 1 to November 30  
Winter: December 1 to February 28

## **SPECIFIC HABITAT ELEMENTS:**

Element categories and definitions are found in “A Guide to Wildlife Habitats of California” (Mayer and Laudenslayer, 1988). A single element has been added since publication and is defined below. A few elements and element categories have been renamed for clarity. There are a total of 124 elements in the CWHR System.

Mine: An excavated underground chamber that is open to the surface where minerals and ore are extracted.

Element ratings are defined for each of three life requisites – reproduction, cover and feeding. Note that a feeding rating may be applied to a non-diet element if it is an essential substrate for a diet item (e.g. mudflats for invertebrates eaten by certain shorebirds or trees with loose bark for insects gleaned by creepers). Model raters should remember to include all elements identified in the species life history account. Ratings are defined as follows:

Essential (E):	The element must be present within the home range of the species if the species is to be present. By definition, no human-made elements should fit this category. If another element is equally valuable in meeting a life requisite, the rating given to an element should be “Secondarily Essential”.
Secondarily Essential (S):	An element which must be present within the home range of the species unless it is compensated by the presence of other secondarily essential elements. By definition, every element with this rating should have at least one “companion” element which also has an “S” rating. No species should be left with only one “S”- rated element.
Preferred (P):	The element is used by the species to a greater degree than its abundance, and the presence of the element <u>enhances</u> habitat value for the species, but the element is not essential for species presence. Elements only incidentally used by a species should be left blank.
Not Rated (–):	The species may use the element, but the presence of the element does not enhance habitat value for the species.

## TEMPLATE FOR SPECIES DATABASE MODEL

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### TAXONOMY:

**Common Name:**

**Scientific Name:**

**Class:**

**Family:**

**Order:**

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### IDENTIFICATION:

**CWHR ID Code:**

**AOU#:**

**TNC ID Code:**

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### LIFE HISTORY ATTRIBUTES:

**Daily Activity:**

**Seasonal Activity:**

**Migration:**

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### SPECIAL STATUS:

Model raters may leave this blank for CWHR staff to complete.

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**SUBSPECIES:**

**STATUS:**

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Model raters may leave this blank for CWHR staff to complete.

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### LOCATION and SEASON IN LOCATION:

Model raters should at minimum delineate seasonal distributions on a 1:1,000,000 scale map using the guidelines for map review contained in this document. CWHR staff will digitize this into a GIS coverage to derive the appropriate location predictions and season-in-location predictions for the database models.

**HABITAT SUITABILITY and SEASON IN HABITAT:**[illegible]

Attach additional sheets as necessary.

## SPECIFIC HABITAT ELEMENTS:

<b>Vegetative Diet Elements</b>	<b>R</b>	<b>C</b>	<b>F</b>
Fungi			
Lichens			
Moss			
Kelp			
Algae			
Graminoids			
Forbs			
Shrubs			
Tree Leaves			
Sap			
Roots			
Seeds			
Acorns			
Grain			
Berries			
Fruits			
Nuts			
Cones			
Flowers			
Nectar			
<b>Animal Diet Elements</b>	<b>R</b>	<b>C</b>	<b>F</b>
Invertebrates			
Insects, Terrestrial			
Insects, Flying			
Aquatic Invertebrates			
Fish			
Amphibians			
Reptiles			

Birds, Small			
Birds, Medium			
Birds, Large			
Mammals, Small			
Mammals, Medium			
Mammals, Large			
Carrion			
Eggs			
<b>Vegetative Cover Elements</b>	<b>R</b>	<b>C</b>	<b>F</b>
Tree Layer			
Shrub Layer			
Herbaceous Layer			
Trees, Hardwood			
Trees, Pine			
Trees, Fir			
Trees, Live With Broken Top			
Trees With Loose Bark			
Trees With Cavities			
Riparian Inclusion			
Aquatics, Submerged			
Aquatics, Emergent			
<b>Dead or Decadent Vegetation Elements</b>	<b>R</b>	<b>C</b>	<b>F</b>
Snag, Small Sound			
Snag, Small Rotten			
Snag, Medium Sound			
Snag, Medium Rotten			
Snag, Large Sound			
Snag, Large Rotten			
Stump, Sound			
Stump, Rotten			

Duff			
Litter			
Slash, Small			
Slash, Large Sound			
Slash, Large Rotten			
Slash, Large Hollow			
Log, Medium Sound			
Log, Medium Rotten			
Log, Medium Hollow			
Log, Large Sound			
Log, Large Rotten			
Log, Large Hollow			
<b>Habitat Edge Elements</b>	<b>R</b>	<b>C</b>	<b>F</b>
Tree/Shrub			
Tree/Grass			
Tree/Water			
Tree/Agriculture			
Shrub/Grass			
Shrub/Water			
Shrub/Agriculture			
Grass/Agriculture			
Water/Agriculture			
<b>Physical Elements</b>	<b>R</b>	<b>C</b>	<b>F</b>
Soil, Friable			
Soil, Organic			
Soil, Gravelly			
Soil, Sandy			
Soil, Aerated			
Soil, Saline			
Barren			

Bank			
Sand Dune			
Burrow			
Cave			
Cliff			
Lithic			
Rock			
Talus			
Steep Slope			
<b>Aquatic Elements</b>	<b>R</b>	<b>C</b>	<b>F</b>
Water			
Vernal Pools			
Ponds			
Lakes			
Streams, Intermittent			
Streams, Permanent			
Rivers			
Mud Flats			
Springs			
Mineral Springs			
Bogs			
Hot Springs			
Tidepools			
Water, Slow			
Water, Fast			
<b>Human Elements</b>	<b>R</b>	<b>C</b>	<b>F</b>
Nest Island			
Nest Box			
Nest Platform			

Transmission Lines			
Buildings			
Fences			
Brush Pile			
Campgrounds			
Pack Station			
Water (Artificial Catchment)			
Dump			
Wharf			
Jetty			
Salt Ponds			
Mine			

## SUMMARY OF INFORMATION IN MAJOR DATA TABLES

The data for each species database model is stored in five major data tables which link on a common field – the CWHR species id code – during queries of the system software. Information on habitats is stored in three major data tables. The tables are summarized below. Data dictionaries for all of these tables follow.

DATABASE TABLE	INFORMATION
SPECIES.DBF	CWHR id code, other id codes, taxonomy, legal status
SUBS.DBF	CWHR id code, subspecific name, legal status
LOCATION.DBF	CWHR id code, season in location by location category (e.g. county)
HABITAT.DBF	CWHR id code; habitat suitability ratings for reproduction, feeding and cover by habitat and stage; season in habitat
ELEMENT.DBF	CWHR id code; element suitability ratings for reproduction, feeding and cover for each element by element category (e.g. diet elements)
COHABS.DBF	Habitats known to occur in each county
HABCROSS.DBF	Dominant plant species, descriptions and map images of each habitat
XWALK.DBF	Crosswalks of CWHR habitats with with several vegetation classification systems

## DATA DICTIONARIES

### SPECIES.DBF

ROW #	NAME	TYPE	W	DESCRIPTION
1	ID	Character	4	Unique four-character alpha-numeric code used to identify a species
2	NAME	Character	35	Common name
3	SCI_NAME	Character	40	Scientific name
4	FAMILY	Character	20	Family
5	ORDER	Character	20	Order
6	CLASS	Character	20	Class
7	TNC_ID	Character	12	The Nature Conservancy ID # (native species only)
8	AOU_ID	Character	6	American Ornithologists Union ID # (birds only)
9	MODEL	Logical	1	“X” indicates the species is modeled in CWHR; a way of sorting the modeled species from the complete terrestrial vertebrate species list for California
10	LHA	Memo	10	Species life history account in text format
11	DAILY_ACT	Character	1	Letter code used to indicate the daily activity pattern of the species: C=circadian, N=nocturnal, D=diurnal, P=crepuscular
12	SEAS_ACT	Character	1	Letter code used to indicate the seasonal activity pattern of the species: Y=yearlong, H=hibernate, A=aestivate
13	MIGRATION	Character	1	Letter code used to indicate the migration pattern of the species: U=unpredictable movements L=local migrator D=distant migrator blank=non-migratory
14	FED_END	Character	1	Row numbers 14-26: “X” indicates the species is listed with that status
15	FED_THR	Character	1	“”
16	CAL_END	Character	1	“”

17	CAL_THR	Character	1	“”
18	CAL_FU_PRO	Character	1	“”
19	CAL_PRO	Character	1	“”
20	CAL_SSC	Character	1	“”
21	FED_PR_END	Character	1	“”
22	FED_PR_THR	Character	1	“”
23	FED_CAN	Character	1	“”
24	BLM_SEN	Character	1	“”
25	FS_SEN	Character	1	“”
26	CDF_SEN	Character	1	“”
27	HARVEST	Character	1	“”
28	INTRO	Character	6	“NATIVE” or “INTROD” used to indicate whether a species is native or introduced to California; used when compiling the complete list of terrestrial vertebrates for the state
29	ELEMREQ	Character	1	***
30	QGROU	Character	5	Used for identifying subgroups of species within a query when users have this option: AAN = Amphibians, Anurans APL = Amphibians, Plethodonts BPA = Birds, Passerines BRA = Birds, Raptors BSH = Birds, Shore Birds MBA = Mammals, Bats MCA = Mammals, Carnivores MMA = Mammals, Marine MRO = Mammals, Rodents RCO = Reptiles, Colubrids RIG = Reptiles, Iguanids RVI = Reptiles, Viperids
31	USER_C	Character	2	Used for identifying user selections during queries
32	TAXA_SORT	Numeric	5	Hierarchical numbering scheme for sorting taxonomically.

33	CHANGETYPE	Character	1	Code used to indicate the type of change made to a record: A=addition, D=deletion, M=modification
34	REASONCODE	Numeric	2	Code used to indicate the reason for a change made to a record (See DATA CHANGE DOCUMENTATION below.)
35	SOURCE	Character	10	Abbreviation for author or source document; source.dbf is lookup table
36	DATE	Date	8	Date on which an actual change was made to the database table
37	INITIAL	Character	2	First and last initials of the person who actually made the change

#### **SUBS.DBF**

ROW #	NAME	TYPE	W	DESCRIPTION
1	ID	Character	4	Unique four-character alpha-numeric code used to identify a species; may be duplicated in this table
2	SUBSP_NAME	Character	35	Subspecific scientific name
3	FED_END	Character	1	Row numbers 3-15: "X" indicates the subspecies is listed with that status
4	FED_THR	Character	1	"
5	CAL_END	Character	1	"
6	CAL_THR	Character	1	"
7	CAL_FU_PRO	Character	1	"
8	CAL_PRO	Character	1	"
9	CAL_SSC	Character	1	"
10	FED_PR_END	Character	1	"
11	FED_PR_THR	Character	1	"
12	FED_CAN	Character	1	"
13	BLM_SEN	Character	1	"
14	FS_SEN	Character	1	"

15	CDF_SEN	Character	1	“”
16	HARVEST	Character	1	“”
17	CHANGETYPE	Character	1	Code used to indicate the type of change made to a record: A=addition, D=deletion, M=modification
18	REASONCODE	Numeric	2	Code used to indicate the reason for a change made to a record (See DATA CHANGE DOCUMENTATION below.)
19	SOURCE	Character	10	Abbreviation for author or source document; source.dbf is lookup table
20	DATE	Date	8	Date on which an actual change was made to the database table
21	INITIAL	Character	2	First and last initials of the person who actually made the change

#### **LOCATION.DBF**

<b>ROW #</b>	<b>NAME</b>	<b>TYPE</b>	<b>W</b>	<b>DESCRIPTION</b>
1	ID	Character	4	Unique four-character alpha-numeric code used to identify a species.
2	CATEGORY	Character	2	Numeric code for location category; locnames.dbf is lookup table
3	LOC_CODE	Character	5	Five-character-maximum code for location. Where possible, location categories are encoded within this. DFG Regions end with a numeric digit, BLM Field Offices with FO, Hydrologic Regions with HR, National Forests with NF, Latilong Blocks with LL, USDA Ecoregions with ER, and CERES Bioregions with BR. The three character county codes are standard for DFG statewide GIS data sets. Locnames.dbf is look-up table.
4	LOC_SEAS	Character	2	Code for exclusive season-in-location category: Y=yearlong species, W=winter visitor, S=summer visitor or breeder, M=migrant

**HABITAT.DBF**

<b>ROW #</b>	<b>NAME</b>	<b>TYPE</b>	<b>W</b>	<b>EXPLANATION</b>
1	ID	Character	4	Unique four-character alpha-numeric code used to identify a species
2	HAB_CODE	Character	3	Unique three-character alpha code used to identify a habitat; habcodes.dbf is lookup table
3	HAB_SIZE	Character	1	Code for size class (tree and shrub habitats), height class (herb habitats) or zone (aquatic habitats)
4	HAB_CC	Character	1	Code for canopy closure class (tree, shrub, and herb habitats) or substrate (aquatic habitats)
5	HAB_SEASON	Character	2	Code for exclusive season-in-habitat category: Y=yearlong species, W=winter visitor, S=summer visitor or breeder, M=migrant.
6	REPRO	Character	1	Code for habitat suitability for reproduction: H=high, M=medium, L=low, blank=not suitable
7	COVER	Character	1	Code for habitat suitability for cover: H=high, M=medium, L=low, blank=not suitable
8	FEEDING	Character	1	Code for habitat suitability for feeding: H=high, M=medium, L=low, blank=not suitable
9	INDEX	Character	1	***
10	HAB_SEQ	Character	2	Used for ordering habitats 1-59.
11	CC_SEQ	Character	1	***
12	SELECT	Character	1	Field for selecting individual records.
13	CHANGETYPE	Character	1	Code used to indicate the type of change made to a record: A=addition, D=deletion, M=modification

14	HABSUITCODE	Numeric	2	Dave Stemer's (1995) codes for changes to habitat suitability ratings based on validation study findings (See DATA CHANGE DOCUMENTATION below.)
15	REASONCODE	Numeric	2	Code used to indicate the reason for a change made to a record (See DATA CHANGE DOCUMENTATION below.)
16	SOURCE	Character	10	Abbreviation for author or source document; source.dbf is lookup table
17	DATE	Date	8	Date on which an actual change was made to the database table
18	INITIAL	Character	2	First and last initials of the person who actually made the change
19	COMMENTS	Character	50	Comments by the person making the change

#### **ELEMENT.DBF**

<b>ROW #</b>	<b>NAME</b>	<b>TYPE</b>	<b>W</b>	<b>EXPLANATION</b>
1	ID	Character	4	Unique four-character alpha-numeric code used to identify a species
2	CATEGORY	Character	2	Numeric code for element category; elecodes.dbf is lookup table
3	ELEM_CODE	Character	10	Ten-character-maximum code for element; elecodes.dbf is lookup table
4	SELECT	Character	1	Field for selecting individual records
6	DECAY	Character	1	Code which applies to dead or decadent vegetation elements and certain vegetation residue elements: S=sound, R=rotten, H=hollow
7	REPRO	Character	1	Code for the importance level for reproduction: E=essential, S=secondarily essential, P=preferred
8	COVER	Character	1	Code for the importance level for cover: E=essential, S=secondarily essential, P=preferred

9	FEEDING	Character	1	Code for the importance level for feeding: E=essential, S=secondarily essential, P=preferred
10	CHANGETYPE	Character	1	Code used to indicate the type of change made to a record: A=addition, D=deletion, M=modification
11	REASONCODE	Numeric	2	Code used to indicate the reason for a change made to a record (See DATA CHANGE DOCUMENTATION below.)
12	SOURCE	Character	10	Abbreviation for author or source document; source.dbf is lookup table
13	DATE	Date	8	Date on which an actual change was made to the database table
14	INITIAL	Character	2	First and last initials of the person who actually made the change

#### **COHABS.DBF**

1	HAB_CODE	Character	3	Unique three-character alpha code used to identify a habitat
2	HAB_NAME	Character	32	Complete habitat name
3	LOC_NAME	Character	44	Complete location name
4	LOC_CODE	Character	10	Five-character-maximum code for location
5	CHANGETYPE	Character	1	Code used to indicate the type of change made to a record: A=addition, D=deletion, M=modification
6	REASONCODE	Numeric	2	Code used to indicate the reason for a change made to a record (See DATA CHANGE DOCUMENTATION below.)
7	SOURCE	Character	10	Abbreviation for author or source document; source.dbf is lookup table
8	DATE	Date	8	Date on which an actual change was made to the database table
9	INITIAL	Character	2	First and last initials of the person who actually made the change

**HABCROSS.DBF**

<b>ROW #</b>	<b>NAME</b>	<b>TYPE</b>	<b>W</b>	<b>EXPLANATION</b>
1	HAB_CODE	Character	3	Unique three-character letter code used to identify a habitat
2	HAB_NAME	Character	32	Complete habitat name
3	HAB_MAP	Binary	10	A map depicting the habitat's general distribution in California
4	HAB_TEXT	Memo	10	Complete description of the habitat in memo format
5	WHRSP_1	Character	24	Primary dominant species or associate
6	WHRSP_2	Character	24	Second-most dominant species or associate
7	WHRSP_3	Character	24	Third-most dominant species or associate
8	SERAL_TYPE	Numeric	2	Code for unique combination of seral stages (13 possibilities); habstage.dbf is look-up table
9	CHANGETYPE	Character	1	A single character letter code used to indicate the type of change made to a record. A=addition, D=deletion, M=modification.
10	REASONCODE	Numeric	2	Numeric code used to indicate the reason for a change made to a record (See DATA CHANGE DOCUMENTATION below.)
11	SOURCE	Character	10	Abbreviation for author or source document; source.dbf is lookup table
12	DATE	Date	8	Date on which an actual change was made to the database table, beginning with changes for Version 7.0. All changes for Version 6.0 were given a default date of 11/30/97.
13	INITIAL	Character	2	First and last initials of the person who actually made the changes

**XWALK.DBF**

<b>ROW #</b>	<b>NAME</b>	<b>TYPE</b>	<b>W</b>	<b>EXPLANATION</b>
1	HAB_CODE	Character	5	Unique three-character letter code used to identify a habitat
2	CROSS	Character	3	Unique code for vegetation crosswalk: CAL= CalVeg CHH= Cheatham and Haller HOL= Holland MCV= Manual of California Vegetation UNE= UNESCO
3	CROSS_TYPE	Character	70	Full name for equivalent vegetation type in the crosswalked scheme
4	CHANGETYPE	Character	1	Code used to indicate the type of change made to a record. A=addition, D=deletion, M=modification.
5	REASONCODE	Numeric	2	Code used to indicate the reason for a change made to a record (See DATA CHANGE DOCUMENTATION below.)
6	SOURCE	Character	10	Abbreviation for author or source document source.dbf is lookup table
7	DATE	Date	8	Date on which an actual change was made to the database table
8	INITIAL	Character	2	First and last initials of the person who actually made the change

## DATA CHANGE DOCUMENTATION FOR CWHR

Documentation fields are included in all of the major data tables in CWHR. These fields include CHANGETYPE, REASONCODE, HABSUITCODE, SOURCE, DATE AND INITIAL. (See DATA DICTIONARIES above for descriptions.) The SOURCE field links with its own lookup table which fully cites the information source for a change. The REASONCODE and HABSUITCODE fields contain codes for what prompts a data change, independent of the information source. The codes found in these fields are described below. Following these descriptions is a form which users may submit for proposing changes to the data, designed to check that users are considering the same assumptions as model developers when suggesting corrections.

### HABSUITCODE

This field is found in habitat.dbf and element.dbf and codes changes to habitat suitability ratings based on validation study findings.

01	The study found an omission error or recommended an increase in suitability for this habitat and stage.
02	Increase in habitat suitability was extrapolated to a related (similar) cover category from a finding within the same habitat and same or similar seral stage.
03	Increase in habitat suitability was extrapolated to a different seral stage from a finding within the same habitat and same or similar canopy cover.
04	Prior to this study, CWHR omitted this species from all stages of this habitat. Study authors found this species in at least one habitat stage and, because of the species' range extension into this habitat, presence in additional and possibly dissimilar stages and cover categories was inferred.
05	Ratings in this habitat were extrapolated to another habitat and assumed to provide the same level of suitability to one or more life requisites.
06	The study found a commission error or recommended reduction in suitability for this habitat and stage and the species was removed or suitability was lowered.
07	Decrease in habitat suitability extrapolated to a related (similar) canopy cover category from a finding within the same habitat and same or similar seral stage.
08	Decrease in habitat suitability extrapolated to a different habitat stage from a finding within the same habitat and same or similar canopy cover category.
09	Addition to or modification of suitability rating for seral stage 6 extrapolated from habitat category 5D. The stage 6 has been excluded even though the species has been included in the 4D and 5D categories. This does not appear to be consistent. The density and age categories are similar and, therefore, one would expect the species to be present.
10	Addition to or modification of this habitat stage based on review of general species literature and inconsistency with the model ratings in adjacent stages.

11	The CWHR habitat suitability rating does not appear to take into account special habitat elements which may be present.
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## REASONCODE

This field is found in all of the major data tables and codes general reasons for data changes.

31	Range map revision	Formal review of CWHR distribution map
33	Expert opinion/ Field observation	Informal field studies; direct communication to CWHR program staff
35	Literature review/ Published information	This is any public written information used to make a change. Changes to habitat suitability levels in habitat.dbf which are extrapolated from published information should also have a value in the habsuitcode field.
41	Taxa split or new species	Published taxonomic change to species.dbf or subs.dbf.
43	Taxa lump	Published taxonomic change to species.dbf or subs.dbf
45	Name change only	Published official name change; affects species.dbf and subs.dbf
47	Special status change	Published special status change; affects species.dbf and subs.dbf
51	New habitat crosswalk	Any change to CWHR crosswalk based on a new vegetation classification system; affects xwalk.dbf
61	New species model	Model addition directed by CWHR program staff; includes modifications and additions due to taxa splits
63	New category of information	Information added because something new is being tracked (eg. added element, new status category)
65	Changes made for consistency with model definitions	Affects mainly element.dbf and the definitions of “Essential”, “Secondarily Essential” and “Preferred”.
71	Changes in CWHR habitat classification	Two agricultural habitats were expanded into eight. Records for cropland and orchard/vineyard were dropped. Ratings were developed for rice and eucalyptus, the final two of the eight to receive ratings.

## A Checklist for Proposing Changes to the California Wildlife Habitat Relationships System

Users are encouraged to propose changes to data in the CWHR system which will improve the reliability of the model predictions. Please complete the form below to propose corrections, additions or deletions to information in the CWHR database based upon the output of a query. Thank you for your input.

\*\*\*\*\*

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Title: \_\_\_\_\_ Agency/Company: \_\_\_\_\_

Suggested change: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\*\*\*\*\*

Version of CWHR used: \_\_\_\_\_

Query parameters:

Habitats and stages \_\_\_\_\_

Habitat suitability levels \_\_\_\_\_

Elements excluded from query \_\_\_\_\_

Exclusion level for elements \_\_\_\_\_

Were habitat parameters field-verified? \_\_\_\_\_

Did you consider the following model assumptions?

\_\_\_\_\_ Habitat suitability ratings for a species in a habitat are statewide rather than bioregional. Suitability of a given habitat for a given species may vary throughout the state, but only one overall statewide rating is assigned. This is likely to represent the average of a range of suitability values.

\_\_\_\_\_ Habitats for species that require juxtaposition of two or more habitats are individually rated as if the other habitats are available in the proper mix.

\_\_\_\_\_ Ratings are developed assuming all special habitat elements are present in adequate amounts if they are typical components of the habitat.

\_\_\_\_\_ Habitats are rated assuming that adequate habitat amounts and patch size exist.

\_\_\_\_\_ The model does not account for species interactions (e.g. competition, predation) within a habitat.

Did you consider the basic logic governing the query process? (This topic is covered in detail in the CWHR training course.)

\_\_\_\_\_ Species presence/absence for location and habitat are calculated with “and” logic rather than made directly. For example, to determine if the Northern Goshawk is predicted to occur in Blue Oak Woodland habitat in El Dorado County, the program will search first for the species in the habitat and next for the species in the location. If the answer is “yes” to both questions, the species will be predicted to occur there. No prediction is made directly for that species in that habitat in that location.

\_\_\_\_\_ There is no connection between the elements databases and the databases for habitat and locations. Excluding elements considered essential for a given life requisite will drop a species off a list regardless of its presence in a given habitat or location.

What is the source of the proposed change? Please attach documentation.

\_\_\_\_\_ Expert opinion/Field observation. Observation should be documented with field notes including observer name, date, location, and CWHR habitat for suggested commission/omission errors. For proposed changes to habitat suitability levels, CWHR habitat, size and cover class should also be included.

\_\_\_\_\_ Published information/Validation study. Copy of article or pertinent parts with full citation should be attached.

\*\*\*\*\*

If you are proposing an original validation study, please consult with CWHR program staff in the course of designing the study. The following references may also be helpful:

For an example of a well-designed validation study, see Hejl, S.J. and Verner, J. (1988) Evaluating avian-habitat relationships in red fir forests of the Sierra Nevada. 1988 Transactions of the Western Section of the Wildlife Society 24: 121-134.

For a discussion on the problems associated with making changes based on validation study findings, see Sterner, D. (1995) Guidelines for making changes to the CWHR model. Unpublished report. California Department of Fish and Game.

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#### CWHR Program Use Only

Are changes necessary? \_\_\_\_\_yes \_\_\_\_\_no

Justification: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Initials \_\_\_\_\_

Date: \_\_\_\_\_

\*\*\*\*\*

Form Updated: April, 1999  
California Wildlife Habitat Relationships Program  
California Department of Fish and Game  
(916) 327-8822

## ***GIS Coverage of Species Distribution***

## PROTOCOLS FOR REVIEWING SPECIES DISTRIBUTION MAPS

The following protocols were designed to guide review of 1:1,000,000 scale maps representing the limits of distribution for a species by season throughout the state.

1. Review and revisions should be made with the fundamental premise that the digitized ranges represent the current maximum geographic extent of the species within the state of California. Maximum geographic extent is defined as the area within the range boundary that the species can be reliably expected to occur (approximately 99% of the known occurrences and expected or known distribution) given suitable habitat conditions. Areas outside of the range boundary represent those areas that the species is not reliably expected to occur. Current is defined as the maximum geographic extent in the current year.
2. Attention should be focused on the currently known distribution. Historical occurrences of known extinct populations can be considered for inclusion in the current distribution only if the reviewer is moderately confident that the species could reoccupy the area within the foreseeable future without human intervention – such as a reintroduction – and habitat conditions would still be suitable to support the species.
3. Distributional boundaries should be delineated to minimize errors of omission (species found outside the mapped boundaries) as much as possible. However, the potential for vagrants, extra-limital occurrences, range extensions, and human transplantsations should be recognized. Distributional boundaries should not be modified to account for these unusual occurrences unless the reviewer feels confident that those types of occurrences will soon become part of a species' regular distribution. The likelihood that a range extension represents a viable expansion of the distribution must be considered on a species-by-species basis.
4. Typically, there will be areas within the delineated distribution where the species cannot be found due to unsuitable habitat or other factors. These areas should be delineated as “cut-outs” or “holes” within the larger distributional areas only if the species cannot be expected to reliably occur there. However, these unoccupied pockets must be large enough to be accurately and precisely mapped at the 1:1,000,000 scale and have biological relevance. There should be internal consistency in the rules applied to any single species' map.
5. Distribution of suitable habitat and occurrence of topographic features, such as elevation, mountain ranges, valleys, rivers, bays, etc., that represent barriers or limits to distribution should be considered in a delineated species' range. However, map boundaries should be drawn according to these factors only when they are of sufficient magnitude to isolate populations. For example, mountain sheep occur in isolated mountain ranges in the desert region, and these populations are effectively isolated from adjacent populations by large barriers of unsuitable habitat in valleys. Furthermore, these barriers must be large enough to be accurately represented on the 1:1,000,000 scale maps.
6. Interspecific, intraspecific, and ecological factors, such as predation, competition, disease, cyclic populations, etc., generally should not be considered when reviewing the distribution maps, particularly when these factors are transitory or temporary in nature. Permanent

range reductions or contractions due to these factors may be considered on a case-by-case basis so long as the defined distribution still represents the current maximum geographic extent.

7. Migratory areas that are not part of a species' breeding or non-breeding distribution are problematic for many reasons. Areas which are migratory-only for a species without any particular geographic or habitat association should not generally be mapped. What is important are migratory areas that are geographically distinct and have important implications for conservation. These may include water bodies, such as lakes, estuaries, bays, etc., where large concentrations of migratory individuals congregate.
8. Geographic attributes of known location, such as rivers, lakes, mountain ranges, elevational gradients, ownerships, etc., that exist on GIS coverages can be mapped consistently with distribution maps for many species. Therefore, the reviewer should indicate location of these attributes as accurately as possible on the revised map, and the map should be annotated to indicate what the attribute is. An example is the Sacramento River which defines the distribution of some riverbank nesting birds such as the Bank Swallow. Breeding range can be consistently delineated for these species using a GIS coverage of California rivers. A consistent buffer zone of 1-5 miles (depending on the species) should be indicated on the maps to enlarge rivers, streams, and other linear habitats so that they are visible on the maps and represent adjacent habitats used by that species. All elevational distribution lines should be annotated on the maps to the nearest 500 elevation contour so that the map digitizer will know the contour line on which to revise the map.
9. Historical occurrences of known extinct populations can be considered for inclusion in the current distribution if the reviewer is moderately confident that the species could reoccupy the area within the foreseeable future without human intervention – such as a reintroduction – and habitat conditions would still be suitable to support the species.
10. Several existing GIS coverages are available for use in the map revisions. These coverages include point occurrences from the California Natural Diversity Data Base, records from the Breeding Bird Survey (BBS) and Christmas Bird Counts (CBC), and occurrence records from National Park Service units (National Parks and National Monuments). Reviewers are to use these coverages and other point occurrence data sets available to them to delineate the distribution boundaries. However, reviewers should be cautious of records from these data sets, particularly for occurrences that are considerably beyond known distribution boundaries.
11. For terrestrial species 1:1,000,000 scale base map of USFS ecological units that breaks the state into relatively large, homogenous polygons of similar vegetation, soils, geological materials, climate, elevation, etc. will be provided for use in map revisions.
12. When each review is complete, the map should be signed and dated and the attached map review form filled out.

**CWHR SPECIES DISTRIBUTION MAP REVIEW FORM**

1. CWHR species alpha-numeric code: \_\_\_\_\_
2. CWHR species common name: \_\_\_\_\_
3. Map type:           \_\_\_Yearlong           \_\_\_Summer           \_\_\_Winter
4. Map reviewer: \_\_\_\_\_

Name:

Address:

Phone/Fax/E-mail:

- |    |                           |     |    |
|----|---------------------------|-----|----|
| 5. | Date review was completed |     |    |
| 6: | Type of changes:          | Yes | No |

Distribution extension:  
(substantial extension of distribution)

Distribution reduction:  
(substantial reduction of distribution)

Distribution modification:  
(slight change to existing distribution)

No change to distribution:

7: Information Sources- (published and unpublished literature, personal communications, museum records, professional judgement):

## DEVELOPMENT OF THE GIS DATA

Species distribution data in CWHR was not originally in a GIS format. Polygons representing distribution were drawn by species experts at approximately 1:5,000,000 scale (the State of California on an 8 ½ x 11" page) and published in "California's Wildlife, Volumes I-III" (Zeiner, et.al; 1988-1990).

A major effort involving Department personnel and contractors began in 1995 to turn these polygons into GIS data and have the resulting maps reviewed. To begin, the 1:5,000,000 scale polygons were digitized by a contractor from the published books. Editing was done by CWHR staff, who added vertices to smooth out the edges of polygons and performed some standardizing of geographic features. The polygons were plotted at 1:1,000,000 scale to be reviewed by species experts using a standard set of map revision protocols (see above) and a standard base map of ecological regions. These experts were also able to take advantage of a variety of spatially-explicit GIS coverages including data on up-to-date species observations, habitat distribution, elevation, and rivers and waterbodies. Each expert was asked to complete a CWHR Species Distribution Map Review Form (see above) to fully document any revisions made.

The expert review of 1:1,000,000 scale maps continues to date, especially for those species whose 1:1,000,000 scale maps have not yet been reviewed. The maplist.dbf table contains fields for reviewer name and date. Those species not yet reviewed are labeled "CWHR PROGRAM" with REVDATE as "08/01/95".

Updates based on expert reviews are digitized by CWHR staff. For updates done in 1999 or earlier, polygons on 1:1,000,000 scale paper maps were digitized on a tablet and edited in ArcInfo. At present, the paper maps are put through a scanner and the resulting image geo-referenced and used as a base map to add and edit shapefiles in ArcView. The shapefiles are then converted back to ArcInfo workspace coverages.

## ORGANIZATION OF THE GIS DATA

CWHR species distribution coverages are organized into four workspaces according to the four major taxonomic groups in CWHR: amphibians; reptiles; birds; and mammals. Each coverage is named according to the 4 character alphanumeric CWHR ID for each species. The file maplist.dbf may be used as a look-up table for species common and scientific names. The common and scientific names and ID code are identical to those in the database files distributed with the CWHR database software.

The CWHR ID alphanumeric codes begin with A, B, M, and R for amphibians, birds, mammals, and reptiles, respectively. The distribution map file names for amphibians, mammals, and reptiles all end in -y because they have yearlong distributions in California. For birds, however, the file names may end in -y, -w or -s for species with yearlong, winter, or summer distributions. Note that the same bird species may have separate winter and summer coverages, while some species have only winter, summer, or yearlong distribution map coverages.

Each coverage contains a single added attribute item called INRANGE. This attribute accommodates donut-holes in the distributions. Most of the coverage polygons have INRANGE = 1, while donut-holes where the species is absent have INRANGE = 0. INRANGE could be used as the symbolitem for the polygonshade command. For example, Arcplot: polygonshades b410-w inrange shades the polygons in the distribution of the species and leaves the donut-holes clear.

The projection for each coverage is Alber's Conformal Conic and is fully described in the coverage's PRJ.ADF file.

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